In the Matters of

International Comparison and Survey Requirements in the Broadband Data Improvement Act	)	GN Docket No. 09-47
A National Broadband Plan for Our Future	)	GN Docket No. 09-51
Inquiry Concerning the Deployment of Advanced Telecommunications Capability to All Americans in a Reasonable and Timely Fashion, and Possible Steps to Accelerate Such Deployment Pursuant to Section 706 of the Telecommunications Act of 1996, as Amended by the Broadband Data Improvement Act	)	GN Docket No. 09-137

COMMENTS OF THE U.S. R&E NETWORKS, NBP PUBLIC NOTICE #22

The U.S. R&E Networks

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SUMMARY

The U.S. R&E Networks strongly believe that a comprehensive National Broadband Plan should embrace not only increased federal support for basic networking research, but also renewed investment in deploying Research and Education ("R&E") networks at the campus, regional, and national levels.

For decades now, there has been an ongoing debate about the best way for basic laboratory research to directly lead to new or improved products and services that create economic benefit. Everyone agrees that initial research needs to be funded. However, there has been considerable discussion regarding whether the middle stage of the process (i.e., the stage after the initial research but before the full-scale commercialization of a concept) also needs to be funded. The answer to this question with respect to the matters discussed herein is a resounding yes. The middle stage of the process for implementing a new concept – which entails utilizing the initial research to design and implement infrastructure and testbeds needed to prove the viability of the concept in a real world environment and to also recognize what modifications are necessary prior to full-scale commercialization – is the critical link between the initial research phase and the full scale commercial deployment.

Indeed, when this middle stage was funded with regard to the Internet, the results were extraordinary. The Internet evolved into the economic and social powerhouse it is today as the result of large-scale demonstrations of new networking technologies in the R&E community. *It was only because the R&E community was able to build an operational network (initially the ARPANET and then the NSFNET) such that its transformational superiority over the then-closed approaches to networking were*

demonstrated. The Internet in its current form exists because the world outside of the R&E community recognized the enormous advantages of an open, extensible network environment and wanted, perhaps even needed, to be a part of it.

The Internet would likely not exist in anything remotely resembling its current form had it not been for the seminal role of the research and education community in its development. It would instead most likely consist of a set of competing, proprietary protocols and networks with limited interoperability between them and with devices that run incompatible software only operating on selected subsets of the networks.

Moreover, the role of the federal government through agencies such as ARPA and NSF in providing much of the early funding to the R&E community cannot be underestimated. It enabled the R&E community to build real, working networks, initially connecting members of the R&E and eventually opening up connections to others that would have been beyond the capabilities of the R&E community to fund internally. Indeed, the fact that these initially R&E-only networks became *the* place where most innovative and exciting network developments and services were transpiring became the primary reason why the commercial world was forced to take note and eventually adopt these standards and then extend these networks globally. The development of the World Wide Web, arguably one of the most significant developments in demonstrating the superiority of an open, standards based approach to networking, can be traced to critical government funding in both Europe (CERN) and the United States (NCSA).

Federal funding is again sorely needed today for the R&E community. Such funding will benefit the U.S. in two critical respects. First, it will greatly enhance scientific research and education now, including in fields such as physics, medicine,

computer science, distance education, bioinformatics, biodiversity and ecological research, geoscience, astronomy and space exploration. Second, it will lay the foundation for future improvements to the everyday Internet for everyone. Thus, such funding will produce a win-win situation for our economy and the general public, both now and in the future. Moreover, this funding will have the broadest impact in ensuring that new developments continue to provide an open networking environment.

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COMMENTS OF THE U.S. R&E NETWORKS, PUBLIC NOTICE #22

Internet2, National LambdaRail ("NLR"), EDUCAUSE, Corporation for Education Network Initiatives in California ("CENIC"), Florida LambdaRail, LLC ("FLR"), Great Plains Network ("GPN"), Indiana University's Global Research Network Operations Center ("GlobalNOC"), Mid-Atlantic Crossroads (MAX), MCNC/North Carolina Research and Education Network ("NCREN"), Memphis Coalition for Advanced Networking ("MCAN"), NYSERNet, Ohio Academic Resources Network ("OARnet"), OSHEAN, Pacific NorthWest GigaPop ("PNWGP"), the Quilt, Three Rivers Optical Exchange ("3ROX"), the Utah Education Network ("UEN") and the University of Utah (collectively, "U.S. R&E Networks") hereby submit these comments.

INTRODUCTION

The U.S. R&E Networks welcome the opportunity to comment on several of the questions raised in Public Notice No. 22 in this proceeding (the "Public Notice"), which Public Notice concerns broadband research and how advanced networking technologies are discovered, developed, deployed and spread into an evolving, innovating Internet. While these comments primarily focus on the issue of the need for federal support of Research and Education network deployment, the U.S. R&E Networks believe these comments are responsive to issues raised in Questions 2, 4, 7 and 9 of the Public Notice.

Set forth below is a description of each of the U.S. R&E Networks that are parties to this filing.

Internet2

Internet2 is a consortium of research universities, federal laboratories and agencies, private companies, and regional optical networks operated by not-for-profits and Higher Education institutions. Internet2 is dedicated to advancing the state of the Internet, and in doing so deploys an advanced national optical infrastructure to serve its members. Together with its regional optical network partners, Internet2 reaches over 66,000 "community anchor institutions," including research universities, colleges and community colleges, K-12 schools, libraries, museums, and science centers, with over 10 million individual users. The members and constituents of Internet2 represent the educational and training platform that produce each successive wave of scientists, engineers, entrepreneurs, clinicians, educators and professionals that drive our economy,

provide innumerable benefits to the public, and ensure our national security. Unfettered access to information that is enabled through access to high-speed, cost-effective networks is central to the success of our nation.

Internet2, its regional partners, and its research university members build and operate the most advanced Research and Education networks ("R&E networks") in the world, and these R&E networks have historically proven to be catalysts for the evolution of the Internet that everyone knows and uses.

NLR

NLR is a consortium of the research and education community that owns and operates an ultra-high performance, 12,000-mile, nationwide, network infrastructure which makes possible many of the world's most demanding research projects and is the innovation platform for a wide range of academic disciplines and public-private partnerships.

EDUCAUSE

EDUCAUSE is a nonprofit association and the foremost community of IT leaders and professionals committed to advancing higher education. EDUCAUSE programs and services are focused on analysis, advocacy, community building, professional development, and knowledge creation because IT plays a transformative role in higher education. EDUCAUSE supports those who lead, manage, and use information technology through a comprehensive range of resources and activities. For more information, visit www.educause.edu.

CENIC

California's education and research communities leverage their networking resources under CENIC, the Corporation for Education Network Initiatives in California, in order to obtain cost-effective, high-bandwidth networking to support their missions and answer the needs of their faculty, staff, and students. CENIC designs, implements, and operates CalREN, the California Research and Education Network, a high-bandwidth, high-capacity Internet network specially designed to meet the unique requirements of these communities, and to which the vast majority of the state's K-20 educational institutions are connected. CalREN consists of a CENIC-operated fiber-optic backbone network to which schools and other institutions in all 58 of California's counties connect via leased circuits obtained from telecom carriers or via fiber-optic cable.

FLR

Florida LambdaRail is a consortium of 12 public and private universities who operate a 1,540 mile state-spanning high speed fiber optic backbone that supports research, education and economic development in the State of Florida.

GPN

The Great Plains Network develops and maintains a high-performance network that meets the needs of the membership's research community; is a resource for cyberinfrastructure to the membership; and supports multi-institutional, multi-disciplinary research and education initiatives that require advanced cyberinfrastructure. GPN members include 24 research institutions in nine states and GPN also connects most

other higher education institutions, school districts and public libraries in those states to Internet2.

GlobalNOC

The Global Research Network Operations Center at Indiana University is a premier provider of highly responsive network coordination, engineering, and installation services that support the advancement of research and education networking. From its support of Internet2's network and National LambdaRail's FrameNet and PacketNet, to the IPGrid optical network, the GlobalNOC has become an unrivaled provider of 24x7x365 expert support for the most advanced research networks in the country and for a growing number of international connections. GlobalNOC network engineers and staff take pride in their ability to work with partners and clients to develop the custom-tailored, responsive, expert support needed to serve the research and education community of today and tomorrow.

MAX

The Mid-Atlantic Crossroads (www.maxgigapop.net) is a regional optical network consortium founded by Georgetown University, George Washington University, the University of Maryland, and Virginia Tech. The MAX mission is to serve the long-term strategic planning, deployment, operation, and coordination for high performance advanced internetworking services and initiatives in the Mid-Atlantic region of the United States. MAX serves the research and education community as well as collaborating organizations from the public sector, private/commercial sector, not-for-profits, and state and federal agencies that require access to leading edge telecommunications technologies.

MCNC/NCREN

MCNC provides advanced communications technologies and support services that enable access to 21st century learning applications that improve teaching, learning, research and collaboration among North Carolina's K-20 education community. MCNC, through its management of NCREN and its predecessor networks, has serviced the advanced networking technology needs of the University of North Carolina General Administration institutions and other higher education clients for the past 20 years. The North Carolina Research and Education Network is one of the nation's first statewide education and research networks. It provides broadband communications technology services and support to K-12 school districts, higher education campuses and academic research institutions across North Carolina. MCNC offers the NCREN network, technology tools and services to guarantee equal access to 21st century learning by providing a future-proof technology network that is the foundation for change and innovation in our educational systems. It creates possibility and provides an equitable educational experience throughout the state.

MCAN

The Memphis Coalition for Advanced Networking was founded in 2009 by a consortium of visionary public and private Memphis area research institutions as a Tennessee not-for-profit corporation. MCAN's mission is to provide next generation broadband communications technologies to advance education, research, public service, and economic development in the West Tennessee and mid-south region. MCAN maintains very high speed communication connections with other network initiatives in

Tennessee and with regional partners in the mid-south to create a statewide high speed education and research backbone with regional connections. Further, MCAN connects the Memphis and mid-south region with the Oak Ridge National Laboratory (ORNL) and with other national and international research and scientific networks, providing Memphis and the mid-south with a significant competitive advantage in research leading to technology transfer and economic development. Founding members include The University of Memphis, The University of Tennessee Health Science Center, St. Jude Children's Research Hospital, and The Memphis BioWorks Foundation.

NYSERNet

NYSERNet is a private not-for-profit corporation founded in 1985 by a consortium of visionary public and private New York State institutions to provide high-speed network connectivity to advance research and educational initiatives in the Empire State. In 2003, NYSERNet began an ongoing project to deploy dark fiber facilities to serve its NYC members, followed in 2005 by the launch of its statewide optical network. NYSERNet's Business Continuity Center, operational in 2007, leverages these extraordinary network facilities to provide NYSERNet's members a cost-effective means of protecting critical data and information systems. One outcome of the NYC fiber deployment was a collocation facility that is home to the global MANLAN peering fabric, northeast nodes for Internet2, NLR, ESNet, and the first landing point in the Americas for research data crossing the Atlantic.

OARnet

The Ohio Academic Resources Network was created in 1987 by the Ohio Board of Regents, through legislation by the Ohio General Assembly. OARnet, consists of more

than 1,850 miles of fiber-optic backbone. The network blankets the state, providing connectivity to Ohio's colleges and universities, K-12 schools, public broadcasting stations, academic medical centers, and state, federal and partnering research organizations. The network supports the collaborative IT initiatives of the Ohio Board of Regents: the Ohio Library and Information Network (OhioLINK), the Ohio Learning Network (OLN), and eTech-Ohio's K-12 network.

OSHEAN

OSHEAN Inc., (pronounced ocean) is a consortium of non-profit organizations that was formed to foster the development of a communications infrastructure for Rhode Island's research, educational, health care, and public service community. OSHEAN is committed to developing network expertise among its member organizations and to creating an environment that encourages collaboration through shared resources, information and expertise.

PNWGP

The Pacific Northwest Gigapop is a not-for-profit, advanced networking organization with national and international reach whose roots go back to the original ARPAnet and NSFnet. PNWGP helped found both Internet2 and NLR, and operates the international Pacific Wave fabric in partnership with CENIC. PNWGP provides robust, highest-speed access to: current state-of-the-art Internet; Next Generation Internet services and technology; and the exclusive R&D testbeds where tomorrow's network technologies are being developed. For more information, please visit http://www.pnw-gigapop.net/.

The Quilt

The Quilt, a coalition of 30 advanced regional network organizations, is a dynamic forum where leaders from throughout the advanced research and education network community build on the intellectual capital and best practices of network service providers worldwide. Based on the participants' combined experiences in operations and development of leading edge technologies, the Quilt aims to influence the national agenda on information technology infrastructure, with particular emphasis on networking. Through this coalition, the Quilt promotes delivery of networking services at lower cost, higher performance and greater reliability and security. The Quilt derives support and funding from a diverse base, including participants, federal agencies, and partners. It also relies on significant volunteer contributions from its participants.

3ROX

The Three Rivers Optical Exchange is a regional network aggregation point providing high speed commodity and research network access to sites in Western and Central Pennsylvania and West Virginia. It provides a virtual network-based research environment that connects the science and engineering community in western Pennsylvania and West Virginia to regional and national cyber-infrastructure resources enabling new research and scientific opportunities nationwide.

UEN and the University of Utah

For over fifteen years, the Utah Education Network (UEN) has provided Internet connectivity, collaboration tools, and curriculum services to all higher and public education in the state of Utah. Its *Research@UEN* project will expand the existing Salt Lake City optical network to deliver advanced connectivity to key partners in the Salt

Lake Valley and northern Utah, including the University of Utah, Utah State University, and Brigham Young University. Through the Summit collaboration in the Intermountain region and in collaboration with the Front Range Gigapop, UEN supports advanced research connectivity to both Internet2 and National LambdaRail (NLR) for the research universities and affiliated organizations in the states of Colorado, Idaho, Utah, and Wyoming. The University of Utah is the state's flagship research institution with its main campus in the principal commercial center, Salt Lake City. The University is an internationally recognized research leader in computer graphics, scientific visualization, genomics, medical imaging, energy, and combustion among other fields. Through a dedicated campus council and an ongoing strategic planning process, the University is pursuing an aggressive cyberinfrastructure (CI) expansion including a new off-campus data center, high performance computational clusters, and new storage capabilities for research data. University CI staff collaborate closely with their peers in the Utah Education Network on the development of advanced networking and educational broadband capabilities in the state.

DISCUSSION

I. *A comprehensive National Broadband Plan should include federal support for basic networking research.*

The recent FCC workshop on Research Recommendations for the Broadband Task Force (November 23, 2009) featured compelling testimony by a wide range of experts on the need for greater federal investment in basic networking research. As discussed at that workshop, fundamental research is always important to ongoing innovation and progress in any field. Moreover, the telecommunications industry is not

funding this type of research, and therefore it is incumbent upon the federal government, through its science agencies, to provide the necessary support.

In that vein, the U.S. R&E Networks strongly support the National Science Foundation's GENI program, as described by Dr. Ty Znati at the workshop. NSF has historically played an important role in funding computer science and networking research, and could do more with adequate funding from Congress.

In addition, DARPA and the Department of Energy ("DoE") have also played critical roles historically. DARPA should return to its past role of leadership in computer and network science. The U.S. R&E Networks strongly support DoE investments, through the Office of Science, in advanced networking, especially via continued deployment and evolution of the Energy Science Network (ESnet).

The networking research of all of these agencies, however, also need to strive for greater coordination. In the past, the National Coordinating Office for Networking and Information Technology Research and Development, which reports to the Office of Science and Technology Policy ("OSTP"), has coordinated federal plans in this area. It may be helpful to revive the President's Information Technology Advisory Committee, which previously provided outside advice to OSTP and the White House on the overall direction of these agencies' IT R&D.

II. *While necessary, increased basic networking research will not be sufficient to assure continued economic innovation and growth. Investment in deploying R&E networks can link basic research with applied and accelerated deployment of advanced broadband in the U.S.*

For decades now, there has been an ongoing debate about the best way for basic laboratory research to directly lead to new or improved products and services that create

economic benefit. "Technology transfer" and "commercialization" efforts have ranged from assigning intellectual property rights (Bayh-Dole legislation) to funding small business grants (SBIR) and emerging technology development (the Commerce Department's ATP) to promoting public-private partnerships through cooperative agreements between federal laboratories and commercial companies.

While everyone agrees that initial research should be funded and wants that research to lead to full-scale commercialization of new products and services that benefit the economy and the general public, there has been considerable discussion regarding whether the middle stage of the process (i.e., after the initial research but before the full-scale commercialization of the product or service) also needs to be funded. The middle stage entails utilizing the initial research to design and implement infrastructure and testbeds needed to prove the viability of the concept in a real world environment and to also recognize what modifications are necessary to the product or service prior to full-scale commercialization.

Those entities opposed to funding of the middle stage use perjorative and inaccurate labels to describe such funding, such as "industrial policy" and "picking winners and losers." Those entities supporting such funding, on the other hand, correctly recognize that without funding for the middle stage, there often is no implementation of the new product or service, and the funded initial research is for naught. Simply put, the middle stage is the critical link, and bridge between the initial research phase and the full scale commercial deployment. Yet, many researchers and venture capitalists alike call this middle stage the "valley of death" – because of the huge funding valley (amount needed for this stage is far greater than amount of funding provided). As a result, the

utility of the initial research for a product or service is often undermined, and the commercial deployment of new technology is frequently halted in its tracks.

No magic bullet answers have emerged to these issues, except in the area of networking. Indeed, when this middle stage was funded with regard to the Internet, the results were extraordinary. The Internet evolved into the economic and social powerhouse it is today as the result of large-scale demonstrations of new networking technologies in the R&E community.[1] *It was only because, as described in further detail in Section V below, the R&E community was able to build an operational network (initially the ARPANET and then the NSFNET) such that its transformational superiority over the then-closed approaches to networking were demonstrated. The Internet in its current form exists because the world outside of the R&E community, after some hesitation from commercial providers (see Section V below), recognized the enormous advantages of an open, extensible network environment and wanted, perhaps even needed, to be a part of it.*

In this area, the past provides a clear roadmap for the future. Renewed federal investments in deploying the next generation of R&E networks will not only serve scientific research and better education now in fields such as physics, medicine, computer science, distance education, bioinformatics, biodiversity and ecological research, geoscience, astronomy and space exploration, but it can lay the foundation for future improvements to the everyday Internet for everyone. Investment in R&E networks can

[1] While the Internet's growth was aided by federal investments for basic research, and by investments of telecommunications companies, those two factors were be no means exclusively responsible for the evolvement of the Internet into what it is today.

be the key element of a strategy of technology transfer and commercialization, one that has proven successful in the past and can be again in the future!

III. *Federal investments in R&E Networks can accelerate the movement of basic scientific discovery in network research into the commercial Internet by serving as a bridge.*

It is critical that the federal government continue to play an important role in the on-going support and funding of research and development in all areas of modern computer telecommunications and networking. This must include not only support for basic research in next generation protocols and architectures, as discussed in Section I, but also support for infrastructure and testbeds for testing these new ideas in actual use, and meeting the needs of the R&E community for access to exponentially increasingly higher speed networks required for large data science projects.

This funding will have the broadest impact in ensuring that new developments continue to provide an open networking environment by concentrating that funding within the research and education community as opposed to proprietary commercial environments. The staggering impact that the current Internet has had on world-wide communications and innovation, and U.S. leadership in that space, is directly attributable to the leadership of the research and education community in pushing and demanding for an open, standards based, environment and in the federal government for funding much of the early research, development, and deployment.

The role of the federal government through agencies such as ARPA and NSF in providing much of the early funding for this research cannot be underestimated as it enabled the R&E community to build real, working networks, initially connecting members of the R&E and eventually opening up connections to others that would have

been beyond the capabilities of the R&E community to fund internally. Indeed, the fact that these initially R&E-only networks became *the* place where most innovative and exciting network developments and services were transpiring became the primary reason why the commercial world was forced to take note and eventually adopt these standards and then extend these networks globally. The development of the World Wide Web, arguably one of the most significant developments in demonstrating the superiority of an open, standards based approach to networking, can be traced to critical government funding in both Europe (CERN) and the United States (NCSA).

IV. *Federal investments in R&E Networks have receded; new demands from data-intensive science, as well as the potential to once again "pull the Internet into the future," requires renewal of federal support.*

As commercial vendors and carriers began to support and embrace the Internet in the early to mid-1990s, a view emerged in Washington that the role of the federal government was no longer needed now that the Internet was in a "competitive" phase. Indeed, this view held that government support for programs such as the Internet should be reserved only for technologies that were in their "pre-competitive" (i.e., initial research) stage, and not for those technologies at the critical middle stage as well.

Alarmed by this political reality, members of the R&E community met to discuss how to ensure that they would be able to continue to fund and deploy next generation networks to meet the at-times unique needs of the R&E community. Out of this evolved organizations such as Internet2 (initially called the University Consortium for Advanced Internet Development/UCAID). While Internet2 and later organizations such as NLR have continued to build and deploy advanced extensions of the Internet and have done an excellent job with limited resources, the fact of the matter is that such entities cannot fund

the tremendous costs involved in the middle stage of the process for implementing important new technologies.

An example of these types of costs relate to the rapidly increasing needs of the research community for very high speed communications with scientific instruments such as the Large Hadron Collider (LHC) at CERN. Much of the commercial Internet views very high speed individual data flows (e.g., between a research user and a server, now in the gigabit/second range and increasing to tens of gigabits/second over the next several years) as a "problem" to be avoided. Indeed, many commercial Internet providers have in place either "traffic shaping and engineering" systems precisely to detect and limit such use or commercial policies that "big science" usage unaffordable in the first place. Even on the campuses where the researchers operate, the campus and regional networks to which the campuses attach are all feeling the competing pressure of meeting the extraordinary needs of researchers as compared to the more commodity types of traffic exemplified by e-mail and WWW access.

That is, the networks needed to support many research activities are increasingly beyond the capability of campuses to fund solely with internal funds, especially as these needs compete with equally strong demand simply to keep up with aggregate capacity for commodity uses. Currently, individual researchers can demand multiples of 10 gigabits/second across transcontinental distances and demand for next generation 100 gigabit/second capabilities are reasonable over the next few years. Some federal agencies, such as DoE, have already recognized the criticality of this need and have funded extensions of activities such as ESnet to move into this next generation. However, this funding is largely targeted at laboratories directly under the purview of

DoE, such as the national DoE labs. Campuses, and the interconnecting regional and national networks such as Internet2 and NLR, are still largely searching for funding sources to meet the campus side, regional, and national implementations that are critical to the future of this country. The costs also swell because of the needs of networking researchers to test ideas for next generation protocols that must operate on network paths independent from the production networks to avoid potential disruption to critical traffic. Yet, as described above, the ability of the R&E community to internally fund the network capacity to meet all of these needs is simply not present.

These demands can be supported by renewed federal investment, not by new greenfields projects, but by building upon and supporting the existing R&E network community. Previously successful programs and funding models would work well in this arena. For example, an updated version of the NSF "High Performance Connections Program" could serve to fund campus cyberinfrastructure needs, including those of data-intensive networking. Additional funding for capital investment programs such as the NSF's ARI and MRI programs could help to support the huge capital costs of upgrading regional and national backbone networks.

V. *The future of the Internet will benefit from investing in the open standards of R&E Networks.*

The Internet would likely not exist in anything remotely resembling its current form had it not been for the seminal role of the research and education (R&E) community in its development. It would instead most likely consist of a set of competing, proprietary protocols and networks with limited interoperability between them and with devices that run incompatible software only, operating on selected subsets of the networks. The most dramatic illustration of this is the one class of public networks where the R&E

community has probably had the least involvement, namely the cellular data networks. The R&E community has largely been absent from involvement in deploying these wireless networks as they require a level of capital investment for both equipment and spectrum that is simply unobtainable by the R&E community. These networks are characterized by multiple incompatible standards, devices that are locked to particular networks, and on-going incentives by network operators to keep the networks and devices proprietary so as to minimize customer choice and portability.

A brief history of the Internet, beginning with the initial research Arpanet, shows that at almost every critical moment in its evolution had it not been for the technical and political leadership of the R&E community the current international communications environment would look very different. Prior to the seminal funding by the US Government through ARPA (Arpanet) and the NSF (NSFNet), commercial interests were pushing for a largely vendor-proprietary networking world. Even well into the early days of the Internet, vendor proprietary networks with names such as SNA (IBM), DECNet (DEC), Appletalk (Apple), IPX (Novell), NetBios (Microsoft) were the primary offerings of the commercial community. As commercial network service providers (e.g., AOL, Compuserve, and others) entered the networking space they too developed offerings that were designed to lock users into their particular offerings. Even commercial user organizations (manufacturers, financial institutions, retail organizations and the like) were largely beholden to the proprietary products of their vendors as their requirement for "vendor support" meant that use of the then largely "open source" implementations of the Internet based protocols were deemed unacceptable for commercial use. It was only initially within the R&E community that their IT organizations and research labs were

willing to take the risk of moving away from vendor-supported offerings as the critical need for interoperability and shared services across institutions and vendors outweighed the security blanket of vendor supported offerings.

Commercial vendors did not adopt the open, standards based networking world quietly either. They continued to develop and push proprietary offerings well into the late 1990s. It was only after the user community demanded an end to these non-interoperable environments that they came to the table, often with less than whole hearted enthusiasm. Had the R&E community not been funded to show the superiority and promise of an open networking world by actually building operational networks where laboratory concepts were proven in day to day use, it is unlikely that such developments would have come from commercial sources, as we see today with the cellular data networks, where even today vendors continue to push for "walled gardens" that make access to competing services difficult.

None of this is particularly surprising nor nefarious. No commercial organization has as its primary interest making it easy for customers to easily move to another vendor. But in terms of national policy, creating an environment that allows for competition and innovation has proven to be sound national policy. Indeed, it has allowed startups (e.g., Google) to enter and compete for market share in ways that would have been impossible had the world remained a set of networking islands. Even the limited success of opening up more competition in the cellular networking world only happened after the Commission demanded that the carriers implement services such as Local Number Portability. To pretend that the vendors would have implemented this on their own without strong government policy is not realistic.

The "win" of the Internet Protocol suite, which cemented the lead of the U.S. in networking research and development over the competing Open System Interconnection (OSI) suite pushed heavily in Europe, was largely attributable to the fact that IP Suite was successfully working at large scale in production within the R&E community as opposed to an alternative which existed largely on paper and in labs. There is a legitimate concern that the investment in operational R&E networks in Europe and Asia is already shifting the power to influence future network directions to those regions. Indeed, China has made a significant investment in the next generation of IP network technology (IPv6) by deploying it within the R&E community in China precisely to take leadership in this space.

VI. *Investing in deploying advanced R&E Networks will speed advances in broadband available to all Americans.*

Renewed federal investment in deploying campus, regional and national R&E networks will have many benefits. First, such investments will provide the broad, underlying "cyberinfrastructure" needed to support the new data-intensive science that is emerging all over the science disciplinary spectrum: from high energy physics to astronomy to biology to environmental science.[2] That cyberinfrastructure can serve the additional purpose of enabling new tools for teaching and learning, for distance education, and for sharing of rich educational resources and content.

But those R&E networks will also serve as large-scale testbeds, demonstration projects, for the advanced broadband that everyone wants to see in U.S. homes, schools,

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[2] See Ex Parte Letter of Internet2, MD Docket No. 08-65, RM-11312 at 3-4 (September 23, 2008) (provides a description of many of the critical projects that R&E Networks support in numerous scientific fields).

and businesses in the future. They will provide students, the "innovators of tomorrow" with capacity to dream up whole new products and businesses (as they already have with Google, Yahoo, Facebook, and countless others).

For network equipment manufacturers, R&E networks provide a place for first large-scale deployment of the newest, most cutting-edge routers and switches and optical gear. This provides a direct migration path for new network technologies, the results of networking research, to make their way into the commercial Internet. Very often, when the newest equipment is deployed first into R&E networks, older technologies and equipment are discounted in the manufacturer's inventory, making more standard network deployment cheaper in the broader environment.

CONCLUSION

For all of these reasons, the U.S. R&E Networks strongly believe that a comprehensive National Broadband Plan should embrace not only increased federal support for basic networking research, but also renewed investment in deploying R&E networks at the campus, regional, and national levels.

Respectfully submitted,

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[3] Gary Bachula has been given authorization by all of the U.S. R&E Networks listed in this filing to submit this filing on their behalf.